

Recommendations for Maximizing the Efficiency and Effectiveness of Existing Water Quality Data Collection and Dissemination

**and for Ensuring that Collected Data are Maintained
and Available for Use by Decisionmakers and the Public**

Report of the California Water Quality Monitoring Council

submitted to

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Executive Summary

[TBD]

Chapter 1: The Data Portal Concept

Need for broader data access and integration

Water is California's most precious resource. It provides an essential lifeline between agriculture, industry, the environment, and urban and rural interests throughout the state. With a growing population of more than 38 million, a limited supply of fresh water, and a range of impacts on both terrestrial and marine habitats and resources, the protection of water for beneficial uses is of paramount concern for all Californians. The State Water Resources Control Board and the nine Regional Water Quality Control Boards (Water Boards) are the primary state agencies responsible for water quality protection. The mission of the Water Boards is to preserve, enhance, and restore the quality of California's water resources, and ensure their proper allocation and efficient use, for the benefit of present and future generations. (The State Water Board Strategic Plan, September 2008). Within the Water Boards, a number of regulatory, planning and assessment programs, such as waste discharge permitting, water quality standards development, and the Surface Water Ambient Monitoring Program (SWAMP) are involved in separate and often uncoordinated water quality monitoring, assessment, and restoration activities. Numerous other state, federal, and local agencies also conduct water quality monitoring and assessment activities within the state, as do regulated entities, environmental organizations, and citizen monitoring groups.

There is a need for summarized and integrated data and information on key issues, as well as for access to data at different levels of spatial and temporal scales. Senate Bill 1070 (Kehoe, 2006) was enacted to address these issues for California. The legislation recognized that comprehensive ambient monitoring and assessment information on environmental changes and conditions over time is crucial to the ability of state and federal environmental agencies to establish priorities, evaluate the success of programs and activities, and report on accomplishments. California has the ability to report on the health of only a portion of its water and related ecosystem resources, due to a lack of well-coordinated monitoring data and the tools to produce consistent regional and statewide assessments. Funding for water quality and related aquatic resource monitoring has fluctuated significantly over the years, and is inadequate to ensure the assessment of all waters. Existing monitoring efforts could be enhanced significantly with increased coordination of the many separate monitoring activities conducted by local, state, and federal agencies, regulated entities, and citizen monitoring groups. Historically, the use of different monitoring protocols and data management systems by these monitoring programs have limited access to these data and hampered our ability to produce broader and longer-term assessments of condition. Better coordination of ongoing monitoring efforts, and more targeted identification of specific monitoring needs, would place California in a better position to obtain additional needed monitoring funding, particularly federal funding. Uniform, consistent approaches to water quality monitoring and assessment and improved coordination of monitoring and assessment activities provide opportunities for increased efficiency, reduced redundancy, and the identification of data gaps.

The legislative findings and declarations of SB 1070 also highlight the fact that Californians do not have ready access to existing basic information about the state's waters and how those waters are protected and restored. By their approval of a constitutional amendment (Proposition 59), California voters have indicated their strong support for open and transparent government. At a minimum, all information that is currently available to agencies should be made readily available to the public via the Internet. In this way, agency managers, the legislature and the public will be able to determine the health of individual water bodies and to obtain an accurate picture of the overall health of our state's waters.

To address these issues, SB 1070 mandated that the California Environmental Protection Agency and the Resources Agency enter into a Memorandum of Understanding to establish the California Water Quality Monitoring Council (Monitoring Council), which is to be administered by the State Water Resources Control Board. The Monitoring Council must report by December 1, 2008 to California Environmental Protection Agency (Cal/EPA) and the Resources Agency its recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are maintained and available for use by decision-makers and the public. This report is intended to satisfy that initial task.

The recently updated Water Board Strategic Plan (State Water Resources Control Board, Strategic Plan Update: 2008-2012, September 2008) identifies a long-range approach to promoting efficiency and effectiveness, organizational and environmental results, and transparency and accountability of Water Board programs. These reflect and reinforce the goals identified in SB 1070, including (1) collaboration with the public, regulated and scientific communities, and other stakeholders to establish specific and realistic goals that will assist in directing efforts towards those activities that demonstrate the most benefit for California's water resources; and (2) the data that is developed by Water Board programs should be accessible and seamlessly displayed in a comprehensive water quality data network that allows regulators, the regulated community, and the public the ability to examine the health of any watershed in the State, identify data gaps, and download data sets for further use or analysis. The ability to network and integrate all State water quality information into a comprehensive data set will go a long way towards improving transparency and accountability, as well as providing a basis for decisions and policies.

[Emphasize the difference between data and assessment products / information and the need for access to both. Describe broad categories of users and the ways their needs differ.]

Barriers and opportunities

While there is broad agreement on the benefits to be gained from improved access to and integration of monitoring data, there are also substantial barriers that currently make it difficult or impossible in many cases to achieve these benefits. These barriers stem from often fundamental differences in program design, data management and analysis approaches, and institutional arrangements related to funding, reporting, and ownership of data. We have grouped such barriers into six categories that we use throughout this report as the basis both for our analysis of currently available programs and tools as well as for the ten-year plan of implementation to meet SB 1070's goals:

1. Strategy, objectives and designs of underlying monitoring programs contributing data
2. Consistency of indicators, methods and QA among data
3. Data management infrastructure and procedures
4. Assessment methods and endpoints
5. Reporting capability targeted at specific audiences
6. Sustainability of the systems needed maintain the information flow and dissemination

For each of these six issue categories, there are three ways in which data integration and wider access can be inhibited. First, program features can be so poorly documented that it is impossible to determine whether and to what degree data are compatible. Second, program strategies and objectives can legitimately differ in ways that preclude data integration. Third, programs may have failed to realize their potential for standardization and integration because of their focus on more narrowly defined agency priorities.

Program strategy, objectives, and designs

Strategy refers to the basic purpose or intent, of monitoring and, more specifically, to the questions monitoring is intended to answer. It implies identifying audience(s) to whom those questions are relevant and the ways in which these strategic questions provide the rationale for all other aspects of a monitoring program. Each element of a program can be evaluated as to whether it effectively answers the strategic questions in terms appropriate for the intended audience(s).

There are two common problems at this strategic level. The first is that core strategic questions are not stated, which makes it impossible to determine whether monitoring designs adequately address audience(s)' needs. The second is that core questions may differ, for legitimate reasons, making it difficult to integrate data from separate programs or to use data for multiple purposes. For example, the Department of Water Resources collects and disseminates near-real-time flow data in California's rivers and streams for purposes of flood warning and flood control. The data are not quality checked rigorously because of the strategic need to supply data quickly and because a high degree of precision is not required to meet the program's stated purpose. Contrast this with the much more precise flow data collected for the purpose of calculating loadings of contaminants. This requirement for greater precision means that data take longer to process and produce. Both strategies are legitimate and useful, but these differences make it impossible in this case to combine the data or use them interchangeably. Where strategic questions and target audiences are not clearly defined, it can become very difficult to make judgments about which data should or can be integrated and for which uses.

Objectives are the more specific statements that link strategic goals to operational monitoring designs. Objectives define time and space scales, indicators, and the comparisons that provide the basis for detailed monitoring designs.

Indicators and methods

For programs whose strategies and objectives are compatible, data integration depends on the degree to which monitoring indicators and sampling, analysis, and quality assurance methods are standardized. Despite the efforts of several wide-ranging efforts to promote such standardization, there remains a proliferation of program-specific methods that impede data integration and broader access. In addition, the large number of agencies and monitoring programs, using a wide range of indicators and methods, make it challenging to achieve the levels of standardization needed to successfully integrate data from this variety of sources. Where standards do exist, maintaining them in the face of ongoing development of new methods and the creation of new programs requires constant attention.

Data management

Data management refers to procedures and systems used to create, process, store, maintain, and transfer data. There is a tendency for programs to create data management procedures and systems to fulfill their immediate needs, without consideration of how the data may be used by others. The large number of programs related to water quality and related aquatic resources makes it difficult to create and implement broadly applicable data management standards. Some efforts toward standardization exist at both regional and statewide level and these efforts provide a solid foundation to build on. Because of the rapid pace of technological change, however, data management standards require constant attention and updating.

Consistency of assessment endpoints

Monitoring data alone are not sufficient to answer questions posed by a program's strategy and objectives. Data must be converted into information by data analysis that focuses directly on fundamental assessment questions, with the goal of making readily understood statements about the degree to which management objectives are being met. For example, "Is it safe to swim in our waters?" may be answered in a number of ways, as illustrated in the example web portal developed as part of this report (see Chapter

4). In this case, the question may be answered by focusing on actual monitoring data, derived beach report card grades, or beach closures, using either current data or trends over longer periods of time. The choice of assessment perspective may thus change the answer to the basic question, “Is it safe to swim in our waters?”

For consistent results, assessments require agreed-upon evaluation frameworks that can be applied to monitoring data from multiple sources and on regional or statewide scales. In California, standards that apply to the quality of water in our lakes, streams, and underground aquifers vary from region to region and location to location. Such differences can stem from differences in the beneficial uses protected or from a lack of coordination. In other instances, particularly for living aquatic resources, standards and other assessment endpoints may simply be lacking. However, consistent assessment methods and endpoints are necessary to evaluate condition, both regionally and statewide, and to make consistent regulatory determinations (e.g., impairment). This in turn requires a level of coordination beyond simply using the same indicators and sampling methods.

Reporting

Timely and consistent reporting of monitoring data, and the metadata needed to demonstrate comparability and to ensure it is used wisely, is crucial to utilizing data to support key decisions. Reports must be produced at a range of time scales appropriate to the concerns of managers, the public, and other audiences. For example, if bacterial monitoring data collected by local agencies to determine the safety of water contact recreation at local beaches is only made available to the state on a weekly basis, the state will be unable to provide sufficient information to allow the public to determine whether it is safe to swim at their favorite beach today. If dissimilar sampling and analytical procedures or assessment thresholds are used to generate the data and evaluate the condition of a beneficial use or resource, and those differences are not made apparent, then such assessment results cannot be used with confidence to identify and prioritize problems and to develop management responses. In addition to formal reports prepared by monitoring and assessment programs, users have also come to expect the ability to prepare customized, or ad hoc, reports using interactive tools to query online databases.

Program sustainability

The integration of data and assessment information, based on the standardization of the program elements described above, requires ongoing attention that is beyond what is needed to conduct monitoring and assessment programs independently. It requires active participation in efforts such as methods development workgroups, laboratory intercalibration studies, and research and development into improved and more broadly applicable assessment methods. In addition, it entails investment in information technology infrastructure that provides users with the capability to access, obtain, subset and/or combine, and work with a variety of monitoring data. This in turn depends on the allocation of staff and funding on a more permanent basis than is typical for many monitoring and assessment programs and the agencies and organizations that manage them.

Opportunities

Despite these often daunting barriers, and abundant evidence in every agency’s history that they are all too real, there is equally compelling evidence that they can be overcome. There are many examples in California of long-term and well-designed monitoring programs that focus on specific management questions and apply standardized methods to produce high quality data. Many of these operate successfully at regional and even statewide scales. [examples] There are also programs that have developed and applied scientifically-based assessment tools that help convert monitoring data into useful information about the condition of the state’s waters and related aquatic resources. [examples] Rapidly developing information technology has provided the basis for implementing data libraries, along with data

access and data visualization tools, that enable a wide range of users to work directly with monitoring data and even create their own assessment reports. [examples]

These successes provide starting points and sources of momentum for the Monitoring Council's efforts. However, they also run the risk of contributing to the lack of coordination and comparability that has hampered past efforts to develop more broadly based assessments. [acknowledge the many technical challenges involved in accomplishing the goals of broader access. State need to provide an overarching philosophy of how to organize and present information to various audiences – lead-in to concept of theme-based web portals. Also refer to Ch. 4 and Council's overall implementation plan and its proposed management structure as ways of dealing with these risks.]

Theme-based web portals

The Monitoring Council described a concept of theme-based web portals that would provide ready access to a variety of water quality-related data and assessment information.

Themes and subthemes

Themes are envisioned as a schema for organizing monitoring programs and identifying specific aspects of water quality and related aquatic resources that provide a focus for assessment and reporting (Table 1). These themes fall into two categories. One category addresses core assessment questions or concerns, such as: Is it safe to eat fish and shellfish from our waters? Is it safe to swim in our waters? What is the condition of fish and aquatic life in our streams? A second category (e.g. stressors and processes, infrastructure) includes additional types of information that are needed for the assessment of questions about condition, status, or trends.

Table 1. Major themes and subthemes relevant to water quality monitoring in California. Themes are presented as a series of nested questions that reflect the major concerns of managers, public, and scientists.

- Drinking water safety
 - Surface water
 - Groundwater
 - Water at the tap
- Seafood consumption safety
- Swimming safety
 - Freshwater
 - Beaches, bays, and estuaries
- Status of aquatic life
 - Wadeable streams
 - Rivers
 - Lakes
 - Coastal waters
 - Shallow marine reefs
 - Intertidal
 - Subtidal benthos
 - Enclosed bays and estuaries
 - Wetlands
 - Fisheries
 - Anadromous fish
 - Freshwater fish
 - Marine fish
 - Invasive species (move to stressors? Appears to be relevant in both contexts)
 - Harmful algal blooms (move to stressors? Appears to be relevant in both contexts)
- Stressors and processes
 - Loadings
 - Flows
 - Levels of contamination
 - Water
 - Freshwater
 - Marine
 - Sediment
 - Freshwater
 - Marine
 - Aquatic life
 - Freshwater
 - Marine
 - Landscape maps
 - Measures of climate change
 - Ocean acidification
- Infrastructure
 - ???

[Where do the following fit in – status of delivered, untreated surface water, specifically for urban, rural, and agricultural water supplies?]

Attributes of effective portals

The term “web portal”, popularized in the late 1990’s, has been used in numerous ways in a variety of contexts. One of the challenges in defining the portal concept stems from the fact that the definition is quite general.

Web portal or Internet portal is one of the most controversial terms in information technology today. [...] Part of the problem of controversy is that many have proposed definitions for the Portal concept. [...] A quick search of the literature and of the Web itself leads one to many, sometimes conflicting definitions for the Portal concept.¹

One common definition is a web site that presents information from diverse sources in a unified way. Such a site would provide a gateway to other sites by organizing and presenting links to these resources in a fashion that reflects users’ progression through a series of questions and/or levels of detail. A web portal that presents information related to a given topic (or theme) would be called a “domain-specific” or theme-based portal. Sites that offer data downloads related to a particular field or topic sometimes call themselves “data portals”. Depending on the theme, the portal may include specific modes of access, availability of metadata, the ability to download data, or to visualize data in a particular way.

The theme-based portal concept endorsed by the Monitoring Council includes all these functions to some degree. For each theme or subtheme, a web-based portal would provide a single, coordinated access point for data, assessment results, and supporting information about broadly meaningful questions. An effective portal would enable users to move between a variety of different views, for example, different spatial scales (national, statewide, regional, county, watershed, and local or site-specific). Perspectives could also include different assessment thresholds, supported by pre-programmed tools that would view the data through different screens. For example, USEPA suggests a range of risk levels in their guidance documents for assessing seafood consumption safety, while OEHHA uses a 10^{-4} risk level to account for the health benefits of consuming fish. Beach bacteria data provide another example, where users might want to screen the data in terms of comparison to compliance standards, the number and location of advisories, or the report card scores developed by Heal the Bay (i.e., A, B, C, D, or F).

Success at achieving these functions depends to a large extent on overcoming the six types of barriers described above. These functions therefore provide the basis for defining a set of key criteria that can be used to rate the state’s existing capability to support access to themes, as well as a design template for improving portals and creating new ones as needed. The following chapters evaluate existing portals for each of the themes and subthemes in Table 1, and present an implementation plan (see also Appendix 1 for more detail) for bringing existing portals (and their underlying monitoring programs) up to a common level of effectiveness.

¹ “Web Portals, History and Direction”, Sochats, Robins, 2002

Chapter 2: Effective Portals

[Present examples of two effective portals, demonstrating how they illustrate the successful application of the attributes described in Ch. 1. First is Council's new Safe to Swim portal, highlighting Heal the Bay's new design and the portal's ability to provide access to several different sources of information. Second is Calfish or Wetland Tracker??? Or, the State of the USA website, which is not fully operational but does an excellent job of presenting the portal concept with some page mockups.]

Chapter 3: Assessing the Themes

While effective portals, such as those described in Chapter 2, have been developed for some of the themes and subthemes listed in Table 1, there are many other themes for which standardized monitoring and assessment programs, accessible through web-based portals, have not yet been developed. The evaluation presented in this chapter provides an assessment of the current status, for each theme and subtheme, in terms of the extent to which they address, and overcome, the major barriers described in Chapter 1. By identifying specific shortcomings for each theme and subtheme, this assessment provides a basis for the implementation plan outlined in Chapter 4.

Evaluation framework

The evaluation framework described in Table 2 is based on a portal's desired functions and the six types of barriers described in Chapter 1.

Table 2. Criteria and rating benchmarks for the evaluation of current theme-based portals.

Evaluation criteria	Rating benchmarks
Strategy, objectives, design	<p>Low: No core questions; no, or many undifferentiated, target audiences; poorly articulated or conflicting objectives; uncoordinated monitoring efforts not focused on questions or objectives</p> <p>Medium: Core questions and target audiences implicit in program design; objectives implicit but only partly standardized and not directly used to structure design effort</p> <p>High: Core questions standardized, clearly stated, and focused on specific audience(s); clearly stated and common objectives address standardized core questions and inform all aspects of design</p>
Indicators and methods	<p>Low: Indicators and methods uncoordinated, not validated; no QA procedures or plan</p> <p>Medium: Indicators and methods validated but not standardized statewide; QA procedures exist but are poorly matched to objectives and not standardized statewide</p> <p>High: Standardized, scientifically validated, and clearly documented indicators, methods, and QA procedures that match monitoring objectives</p>
Data management	<p>Low: No data management procedures or documentation</p> <p>Medium: Data management procedures exist but are not standardized statewide and only poorly support access to data</p> <p>High: Standardized and clearly documented data management procedures are standardized statewide and fully support access to data at multiple levels</p>
Consistency of assessment endpoints	<p>Low: No data analysis or assessment procedures used or documented</p> <p>Medium: Data analyzed but methods not standardized; assessment tools exist but not fully validated or standardized</p> <p>High: Data analysis methods and assessment tools fully validated, clearly documented, and standardized statewide</p>

Evaluation criteria	Rating benchmarks
Reporting	<p>Low: No reporting process or products</p> <p>Medium: Intermittent reports, available with some effort</p> <p>High: Readily available regular reports focused on core questions and objectives; ability to create user reports from multiple perspectives</p>
Program sustainability	<p>Low: No systematic program evaluation, planning, or long-term funding devoted to infrastructure needs related to standardization and data integration</p> <p>Medium: Intermittent internal program review and planning that may or may not include infrastructure needs; limited funding for infrastructure</p> <p>High: Regular external program evaluations and planning for all program needs</p>

In the portal evaluations summarized below, we are applying the evaluation criteria to the entire theme / subtheme, not to individual programs or current websites. Thus, the evaluation of a given theme may include more than one program and/or website. This systematic and global evaluation enables the status of all themes to be compared in relation to a consistent standard. This will help identify major redundancies and gaps in the current system of monitoring programs and portals, as well as help determine how close to or far from ideal the major themes as subthemes are. These ratings will also provide a structure for developing an implementation plan, i.e., defining what must be done to bring all ratings up to “high”.

The following section presents an overall evaluation summary (Table 3) that rates each theme and subtheme on the six criteria described above. Each theme and subtheme is then described in a brief fact sheet intended to furnish background information that supports the summary rating on the six criteria and provides a starting point for the implementation plan presented in Chapter 4. Fact sheets are organized according to the following template:

- Title
- Website(s) (if applicable)
- Sponsor(s)
- Brief description, including purpose
- Agencies contributing data
- Evaluation in terms of the six criteria
- Additional monitoring programs that could be relevant

Portal ratings

Table 3 presents an overall summary of the rating of each theme and subtheme on the six evaluation criteria and is followed by individual fact sheets for each theme and subtheme. The evaluations focus primarily on the major statewide and/or regional programs that provide a basis for overall statewide assessments of condition. Additional programs that are more restricted in scope are simply listed, as secondary targets for subsequent phases of evaluation, standardization, and integration efforts in the implementation plan. Finally, any monitoring program that measures a constituent related to a theme or subtheme produces data that are potentially useful in assessment. However, these programs are so numerous, diverse, and, for the most part, restricted in spatial scope, that we have not included this larger set of monitoring programs in the following evaluation.

Note that the evaluation of each theme and subtheme is matched with a set of specific implementation actions that are detailed in Appendix 1.

Table 3. Summary ratings for each theme-based portal on each of the evaluation criteria. [Will be filled in as more programs / portals are evaluated.]

Theme-based portals	Strategy, objectives, design	Indicators and methods	Data management	Assessment endpoints	Reporting	Sustainability
<i>Drinking water safety</i>						
Surface water	High	High	High	High	High	High
Groundwater	High	Medium	Medium	High	Medium	Low
Water at the tap						
<i>Seafood consumption safety</i>						
Sportfish	Medium	High	Medium	High	Medium	Low
Shellfish	High	High	Medium	High	High	Low
<i>Swimming safety</i>						
Freshwater	Low	Medium	Low	Low	Low	Low
Beaches, bays, and estuaries	High	High	High	High	High	Low
<i>Status of aquatic life</i>						
Wadeable streams	High	High	Medium	High	Medium	Medium
Rivers	Low	Low	Medium	Low	Low	Low
Lakes						
Coastal waters						
Shallow marine reefs	High	Medium	Medium	Medium	Medium	Low
Intertidal	High	Medium	Medium	Medium	High	Low
Subtidal benthos	High	High	Medium	Medium	Medium	High
Enclosed bays and estuaries	Medium	Medium	Medium	Medium	Medium	Medium
Wetlands	Medium	Medium	Medium	High	Medium	Medium
Fisheries						
Anadromous fish	Medium	Medium	Medium	Medium	High	Low
Freshwater fish						
Marine fish						
Invasive species						
Harmful algal blooms						
<i>Stressors and processes</i>						
Loadings						
Flows	Medium	Medium	High	Medium	High	Low
Levels of contamination						
Water						

Theme-based portals	Strategy, objectives, design	Indicators and methods	Data management	Assessment endpoints	Reporting	Sustainability
Freshwater						
Marine						
Sediment						
Freshwater						
Marine						
Aquatic life						
Freshwater						
Marine	High	High	Low	Medium	Low	Low
Invasive species						
Harmful algal blooms						
Landscape maps						
Measures of climate change						
Ocean acidification						
<i>Infrastructure</i>						
???						

Drinking water safety

Drinking water safety is a concern for all bodies of freshwater, both surface water and groundwater, that may be sources of drinking water. Risks to human health are managed by state and local standards for permissible levels of certain contaminants. Surface water quality is monitored Statewide by the USGS National Water Quality Assessment program, as well as by a large number of NPDES and regional assessment programs. Groundwater quality, including wells, is monitored and tracked by the State Water Board's GAMA and GeoTracker programs. Drinking water systems that supply water to the tap are managed and monitored according to requirements set by the Department of Public Health's Drinking Water Program and Drinking Water Source Assessment and Protection Program.

Surface water

Website: NAWQA – <http://ca.water.usgs.gov/nawqa.html>; DWR State Water Project (SWP) – <http://www.womwq.water.ca.gov/GrabSamplePage/index.cfm>; CIWQS – <http://www.swrcb.ca.gov/ciwqs/>

Sponsor: NAWQA – US Geological Survey; SWP – DWR; CIWQS – State and Regional Water Boards

Description: Surface waters are monitored by an integrated, statewide monitoring program designed and implemented by USGS as part of its National Water Quality Assessment Program (NAWQA). NAWQA in California focuses on the Sacramento, San Joaquin, and Santa Ana river watersheds. NAWQA was initiated in 1991 to assess the status of and trends in the quality of freshwater streams and aquifers, and to provide a sound understanding of the natural and human factors that affect the quality of these resources. The Department of Water Resources also monitors chemical water quality monthly at 40 stations along the State Water Project. In addition, surface water quality, including for drinking water beneficial uses, is monitored throughout the state under the terms of individual NPDES permits for permitted discharges. These NPDES monitoring programs are typically completely independent and uncoordinated, although they submit raw monitoring data, as well as assessment information on permit compliance, to the California Integrated Water Quality System (CIWQS) statewide database.

Evaluation:

1. Strategy, objectives, design: Both the USGS and SWP programs ask and answer clear questions, with specific audiences in mind. However, the objectives of the USGS program are also defined at a range of scales, from nationwide to basin-level, all related to the basic purpose of tracking patterns and trends in water quality. Designs for both the USGS and SWP are clearly defined, although the USGS design is also nested within nationally and regionally standardized frameworks. NPDES programs that address the drinking water beneficial use are site-specific and generally not standardized or coordinated regionally or statewide

Score: High

2. Indicators and methods: Indicators for the USGS program are well developed and standardized nationally and regionally. Quality assurance is a centrally important feature of all USGS programs, with formal procedures established and documented by the National Water Quality Laboratory. Additional, study-specific quality assurance issues are addressed in the methods section of each assessment report. Indicators and quality assurance methods for the SWP program are standardized statewide and well documented on the program's website. Indicators and quality assurance methods for NPDES programs are site-specific and generally not standardized or coordinated regionally or statewide

Score: High

3. Data management: Data management procedures for the USGS program are well established, standardized nationwide, and clearly documented. Data are housed in readily accessible databases and can be searched and downloaded from a variety of perspectives, including by drop-down lists of locations and data types, or through map-based interactive interfaces. The program's website

has clear instructions and tutorials for public access and to provide data downloads to a variety of formats, including GIS. Data from the SWP are available for download only in tabular form and for individual months. NPDES permitted dischargers submit permit-mandated monitoring data and compliance assessments directly to the California Integrated Water Quality System (CIWQS) via Electronic Self Monitoring Reports (ESMR2). Data formats are standardized statewide and CIWQS provides a variety of query and data download functions.

Score: High

4. Consistency of assessment methods: A variety of analysis and assessment approaches are used by the USGS program to address questions at the national, regional, and basin-specific levels. These approaches are subject to both internal and external peer review. NPDES permitted dischargers provide compliance information to CIWQS in standardized formats; however the monitoring and compliance provisions of individual permits are site-specific and generally not standardized or coordinated regionally or statewide

Score: High

5. Reporting: USGS assessment reports are the primary vehicle for disseminating program results and are readily available on the program's website. These cover a wide range of topics related to water quality and the processes affecting it. However, there are no interactive features in these reports to enable users to focus on a specific area or directly obtain the underlying data through a link to the database. CIWQS provides a number of assessment reports with interactive ad hoc query tools that permit users to define the scope of each report and download the report. CIWQS is creating additional reports as prioritized by stakeholder working groups.

Score: High

6. Program sustainability: The USGS program does not undergo a formal external review, but its methods, designs, assessment approaches, and products are continually reviewed and commented on by peer reviewers, partners, and customers. In addition, year-to-year and longer-range planning occurs at the national and regional levels within USGS. This planning includes staffing and infrastructure needs, but is subject to the uncertainties of the federal budget process. CIWQS has developed a formal business plan that includes funding and staffing requirements.

Score: High

Additional monitoring programs: Other surface water programs that collect data potentially relevant to drinking water safety include several additional DWR programs such as the Municipal Water Quality Investigations (MWQI) in the Delta, a number of regional watershed monitoring programs, the Department of Pesticide Regulation's Surface Water Protection Program with its online database of pesticide detections at the county level, monitoring under waste discharge requirements (Non-15???) for discharges to land, Title 27 discharge monitoring conducted by landfills, site cleanup and Department of Defense program monitoring, and surface water monitoring conducted by water purveyors.

Groundwater

Websites: GAMA – <http://www.waterboards.ca.gov/gama>; GeoTracker – <https://geotracker.waterboards.ca.gov/>

Sponsor: GAMA – State Water Board, US Geological Survey; GeoTracker – State Water Board

Description: GAMA is a cooperative program of the State Water Board and the USGS that addresses concerns about groundwater contamination and its impacts on public water wells and water supply. GAMA is a comprehensive ambient groundwater quality monitoring plan with the objectives of improving statewide ambient groundwater quality monitoring and assessment and increasing the availability of information about groundwater quality to the public. GeoTracker is a State Water Board database that centralizes locally-collected information about spills, groundwater contamination, and cleanup status.

Evaluation:

1. Strategy, objectives, design: Both programs ask and answer clear questions, with specific audiences in mind, but their strategies are not coordinated. GAMA's objectives are clearly stated on the program's website and in a number of descriptive and technical program documents. More general objectives (e.g., better understand and identify risks to ground-water resources) are then supplemented with detailed monitoring objectives linked to specific monitoring designs. GeoTracker's objectives are to gather, organize, and provide access to information on cleanup sites in California. The programs' objectives are not coordinated. GAMA is based on an integrated statewide design based on a division of the state into a number of groundwater basins ranked by a systematic prioritization process. The design is described in technical documents available on the program's website. GeoTracker does not itself conduct any monitoring. Data are submitted by local agencies in compliance with State Water Board regulations that require the electronic submittal of information on all cleanup actions. The programs' designs are not coordinated
Score: High
2. Indicators and methods: GAMA samples a standardized set of indicators sampled statewide. Indicators include a broader set of parameters, sampled at much lower detection limits, than required by DHS. Indicators and sampling methods are described in technical documents available on the program's website. GeoTracker clearly defines information types in the electronic submission procedure; these include primarily programmatic information such as cleanup status. The programs' indicators are not coordinated. Quality assurance is a centrally important feature of all USGS programs such as GAMA, with formal procedures established and documented by the National Water Quality Laboratory. Additional, study-specific quality assurance issues are addressed in the methods section of each assessment report. GeoTracker includes no description of any quality assurance screening of submitted data, nor of how data are generated and evaluated at the local level. It is thus not possible to judge the quality of data in the GeoTracker database
Score: Medium
3. Data management: GAMA's data management procedures are well established, standardized statewide, and clearly documented. However, there are no query or download features to enable users to search, select, and download data. A planned link with the GeoTracker website will provide these functions. GeoTracker's data management procedures are not described on the website, but must be defined somewhere in order for the program to function. The system has an online tutorial that provides instructions for data access and download
Score: Medium
4. Consistency of assessment methods: GAMA uses a variety of analysis and assessment approaches to address questions at the national, regional, and basin-specific levels. These approaches are subject to both internal and external peer review. GeoTracker conducts no analysis or assessment
Score: High
5. Reporting: GAMA uses assessment reports as the primary vehicle for disseminating program results and these are readily available on the program's website. Reports cover a wide range of topics related to program methods and monitoring and assessment results. However, there are no interactive features in these reports to enable users to focus on a specific area or directly obtain the underlying data through a link to the database. GeoTracker enables users to search the database by a variety of entry points, including county, groundwater basin, watershed, and address. Search results include maps, project status, and background information
Score: Medium
6. Program sustainability: There is no readily available description of a periodic program evaluation or planning process
Score: Low

Water at the tap

[DPH Division of Drinking Water and Environmental Management and its Drinking Water and Drinking Water Source Assessment (this mostly a paper exercise and no monitoring data associated with it) and Protection Programs]

Seafood consumption safety

Seafood consumption safety is a concern in streams, rivers, lakes, coastal waters, and bays and estuaries where sport and commercial fishing, and shellfish harvesting, have been designated as beneficial uses. Both federal and state agencies have jurisdiction over this issue, but only the federal Food and Drug Administration (FDA) sets specific action levels and these only for commercial fish. California's Office of Environmental Health Hazard Assessment (OEHHA) sets threshold levels for certain chemicals in sportfish as the basis for establishing site- and species-specific consumption advisories. Neither federal nor state agencies conduct systematic tissue monitoring for risk assessment. OEHHA, however, has used monitoring data collected for other purposes for its assessments. For example, OEHHA has used data from SWAMP's statewide assessments of sportfish tissue contamination. Although these studies were not originally designed to support human health risk assessment, efforts are underway to adapt the monitoring design to better support OEHHA's needs. A second program, coordinated by the Department of Public Health in cooperation with a number of academic and other institutions, conducts statewide monitoring of shellfish and marine biotoxins in coastal waters and bays and estuaries.

Sportfish

Website: OEHHA Fish Consumption – www.oehha.ca.gov/fish/so_cal/index.html

Sponsor: Office of Environmental Health Hazard Assessment (OEHHA), State Water Board

Description: SWAMP's sportfish tissue assessment is intended to answer key questions about patterns of contamination in sportfish tissue in three major habitat types statewide – lakes, coastal environment, and streams. The major focus of this study is the 305(b) water quality assessment, not specifically human health risk assessment. Tissue data were obtained from a wide range of available sources to provide an initial statewide assessment and this was followed by a statewide survey of lakes in 2007 and 2008. The coastal habitat will be sampled next, followed by the stream habitat, before cycling back to lakes in subsequent years. There is the possibility that SWAMP's program could be revised to better address seafood consumption risk, but this has not yet occurred.

Evaluation:

1. Strategy, objectives, design: SWAMP's assessment asks and answers clear questions, with specific audiences (specifically 303(d) listing and 305(b) assessment) in mind; however, this strategy does not focus specifically on consumption safety, nor is it coordinated with those in the shellfish subtheme. While the program began with an assessment of all readily available data that passed a quality assurance screening, the statewide long-term monitoring design is a combination of probabilistic sampling intended to characterize statewide conditions and targeted sampling that focuses on the most popular fishing sites

Score: Medium

2. Indicators and methods: Indicators, i.e., tissue measurements, are standardized, with well-developed sampling and laboratory procedures. Quality assurance methods are well developed and described in the SWAMP QAPP. Data must meet SWAMP standards before entry into the SWAMP database

Score: High

3. Data management: Data management procedures are well established, but data have yet to be placed into a readily available format usable by OEHHA and the State and Regional Water Boards. Data are currently stored at SFEI and are not yet available online

Score: Medium

4. Consistency of assessment methods: OEHHA has developed a formal data analysis framework for the purpose of developing consumption advisories and is working closely with SWAMP to implement standardized assessment methods
Score: High
5. Reporting: Draft reports are being prepared for the initial phases of this program to meet SWAMP's 305(b) reporting responsibilities. OEHHA posts reports and consumption advisories on its website. The longer-term plan is to make all data available through an online interactive mapping tool being developed at SFEI for the Fish Mercury Project being funded primarily by CALFED
Score: Medium
6. Program sustainability: There is no readily available description of a periodic program evaluation or planning process for either SWAMP or OEHHA, although SWAMP is currently developing a formal business plan
Score: Low

Shellfish

Website: Biotoxins and shellfish –

<http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Shellfish.aspx>.

Sponsor: Department of Public Health

Description: The Department of Public Health's Preharvest Shellfish Protection and Marine Biotxin Monitoring Program monitors commercial shellfish growing areas in conformance with the National Shellfish Sanitation Program. The program also monitors numerous points along the California coastline for marine biotoxins in shellfish and toxigenic phytoplankton in marine waters. Warnings are issued or quarantines are established as needed for recreational and commercial shellfish harvesting. These programs are separate and not coordinated.

Evaluation:

1. Strategy, objectives, design: The program asks and answers clear questions, with specific audiences in mind. The objective has been clearly stated and is to describe broad trends over time, and DPH's objective is to establish sanitary requirements for shellfish growing waters and to regulate commercial growing and harvesting to ensure shellfish are safe for human consumption. The monitoring design is based on national guidelines promulgated by the Food and Drug Administration, although these allow for a degree of local flexibility. Monitoring is conducted by a wide range of collaborating local partners and is more organized and consistent for shellfish growing sites than for phytoplankton and toxins in marine waters
Score: High (with a need for more coordination of phytoplankton and toxin sampling)
2. Indicators and methods: Taxonomic methods for phytoplankton identification and methods for the direct measurement of marine biotoxins are not standardized. However, NOAA is organizing a nationwide methods intercalibration study for 2009, with the goal of improving standardization of methods for species identification and estimating abundance, as well as for toxin identification and measurement. Laboratory quality assurance methods are defined in a national procedure manual, however, there is no readily available information on the degree to which these standards are met, or on data checking and validation methods further along the data path
Score: Medium
3. Data management: There is no readily available information on data management procedures. However, the program produces aggregated statewide reports, which requires that data be collected and housed in a statewide database. The program does not provide users a means to access and download data. However, it has recently implemented a statewide listserve to enable participants to more readily share data and results
Score: Medium

4. Consistency of assessment methods: Standardized data summarization approaches are used, with assessment thresholds applied to data on toxin levels in shellfish as a basis for regulatory decisions. However, there may be need to develop assessment thresholds for phytoplankton and toxins in marine waters
Score: High
5. Reporting: The program regularly produces monthly, quarterly, and annual reports, which are posted on the program's website. However, users cannot create reports based on individual criteria
Score: High
6. Program sustainability: There is no readily available description of a periodic program evaluation or planning process
Score: Low

Swimming safety

Swimming safety is a concern in streams, rivers, lakes, coastal waters, and bays and estuaries where body contact recreation has been designated as a beneficial use. Risks to human health are managed by freshwater and marine standards for permissible levels of a set of bacterial indicators. There is a coordinated program in place for assessing and reporting on risks in coastal waters and bays and estuaries, but no similarly coordinated activity for freshwater systems.

Freshwater

Website: NA

Sponsor: Local and, in some cases, regional water quality agencies.

Description: There is no web portal for freshwater monitoring data. There is little coordinated monitoring for human health risk in freshwater systems (i.e., streams, rivers, lakes) and no standardized assessment, reporting, or data access tools.

Evaluation:

1. Strategy, objectives, design: Freshwater monitoring (where it exists), focuses on a clear question, with specific local audiences in mind. The monitoring objective is to meet management / assessment needs and the public's interest in reliable, current information about water quality conditions where body contact recreation occurs. However, this objective is often poorly articulated. Monitoring designs often do not match the strategy and objectives, follow no standardized guidelines, and are not optimized for efficient information return
Score: Low
2. Indicators and methods: Indicators for all habitats are standardized and well developed, but there is no standardized or systematic quality assurance implemented for the various separate monitoring programs
Score: Medium
3. Data management: There are no systematic data management procedures or systems in place; all data are managed at the local county level. There is no process for aggregating data at the statewide level
Score: Low
4. Consistency of assessment methods: There are no consistent data analysis or assessment procedures established, other than simple comparisons to compliance thresholds
Score: Low
5. Reporting: Depending on the individual county, advisories are available via phone or are posted on the county website, for those counties that conduct monitoring. There are no summary reports at the regional or statewide level
Score: Low

6. Program sustainability: All program planning and management occurs at the county level and there are substantial differences in the levels of activity, staffing, and funding from county to county
Score: Low

Beaches, bays, and estuaries

Website: State Water Board Beaches –

http://www.waterboards.ca.gov/water_issues/programs/beaches/beach_water_quality/index.shtml; Heal the Bay Beach Report Card – <http://www.healthebay.org/brc/statemap.asp>

Sponsor: State Water Board, Heal the Bay

Description: For coastal waters and bays and estuaries, both the State Water Board's Beach Water Quality website and the Beach Report Card system hosted at Heal the Bay's website aggregate shoreline monitoring data collected at the county level into a statewide database. However, Heal the Bay's website also applies a standardized risk-based water quality grading system to all data to generate report card grades that are presented on a map-based interface. The beach grading system was developed through a collaborative statewide effort.

Evaluation:

1. Strategy, objectives, design: Programs ask and answer a clear question for specific audiences. The monitoring objective is clearly articulated and related to monitoring designs. The objective is to meet management / assessment needs and the public's interest in reliable, current information about water quality conditions where body contact recreation occurs. Monitoring designs match the strategy and objective and follow guidelines established by the State Water Board's Beach Water Quality Workgroup. However, designs implemented by local and regional agencies are not fully standardized

Score: High

2. Indicators and methods: Indicators and sampling methods for all habitats are standardized and well developed; however, they are not fully described or referenced on available websites. Laboratory intercalibration studies have improved quality assurance at the regional level, but implementation is the responsibility of individual reporting agencies. These quality assurance procedures are not described on available websites, except in passing

Score: High

3. Data management: Data pathways and processing are well-developed and standardized among participants, although there is room for reducing duplication of effort between Hel the Bay and the State Water Board. A standardized set of data management tools enables local and regional agencies to load their data to a statewide database in a common format. However, these data management procedures and systems are not described on available websites. Underlying monitoring data are not available for download

Score: High

4. Consistency of assessment methods: Analysis and assessment for coastal waters and bays and estuaries follows standardized protocols agreed on by all parties; grading methods are described in detail on the Beach Report Card website, with reference to water quality standards. Assessment results are readily available on both the State Water Board's and Heal the Bay's websites

Score: High

5. Reporting: Packaged reports summarizing key indicators are available on the State Water Board website and interactive reporting tools on the Beach Report Card website at several levels of detail. The Heal the Bay system provides map-based entry for report cards and site history, as well as the ability to search lists by beach for closures and history. Beach grades are available via texting to cell phone or other hand-held device. The graphical history of grades and closures for each beach is also available

Score: High

6. Program sustainability: Monitoring is conducted by a variety of local agencies, each with its own planning and funding process. The State Water Board and Heal the Bay data aggregation efforts and websites are managed and funded separately. There is no readily available description for any of these programs of a periodic program planning or evaluation process

Score: Low

Status of aquatic life

The protection of aquatic life is a central part of the management and regulatory programs maintained by CalEPA and The Resources Agency. For example, the protection of aquatic life beneficial uses is mandated in NPDES discharge permits and the Department of Fish and Game monitors the status of many marine and freshwater fisheries stocks. Aquatic life is managed from both species-specific (e.g., Coho salmon) and a habitat (e.g., rocky reefs) perspectives.

Wadeable streams

Website: SWAMP Wadeable Streams Assessment –

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/reports/assess_socal2004.pdf

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/factsheets/305breport2006.pdf

Sponsor: State Water Board

Description: This program, conducted by the Surface Water Ambient Monitoring Program (SWAMP), is intended to answer key questions about water quality and biological condition in wadeable streams statewide. A randomized design with standardized indicators provides the ability to assess overall water quality and ecological condition, estimate the proportion of wadeable streams falling into different categories of condition, and track changes in these measures over time. Monitoring results also help in prioritizing problem areas for further investigation. The program is implemented as a cooperative effort between the State Water Board and the Regional Water Boards.

Evaluation:

1. Strategy, objectives, design: The program asks and answers clear questions, with specific audiences in mind. The monitoring objective is to assess the percentage of stream miles falling into different condition categories and to track how those percentages change over time. The monitoring design is specifically tailored to match the strategy and objective. It is well-described, standardized, and implemented consistently statewide

Score: High

2. Indicators and methods: Indicators are centrally developed and standardized, with training available in field procedures. There is ongoing methods research to develop indicators applicable to a wider range of stream types, as well as to determine if CREAM (California Rapid Assessment Protocol) can provide equivalent results for less cost. Procedure manuals and indicator descriptions are available on the SWAMP website. Quality assurance is a central part of the program, with standardized methods and data required to meet SWAMP standards before entry into the SWAMP database

Score: High

3. Data management: Basic data management procedures are well established; however, SWAMP formats for bioassessment data have not been finalized. Nor have tiered quality assurance requirements been developed for the inclusion of monitoring data from other sources (e.g., regional monitoring and NPDES permit monitoring programs). Data from the SWAMP are stored in the BDAT / CEDEN database in a standardized format and are available for search and download to any interested user

Score: Medium

4. Consistency of assessment methods: Analysis and assessment follows detailed and standardized protocols described in the assessment report and in greater detail in a series of technical reports

available on the SWAMP website. The assessment approach allows for examination of status and trends at the statewide, regional, watershed, and site-specific level

Score: High

5. Reporting: A statewide assessment report is available on the SWAMP website. However, there are no interactive features to enable users to focus on a specific area or directly obtain the underlying data through a link to the database. In addition, the SWAMP website is not structured for ease of access to themes or program areas. The website is currently being redesigned to address these problems

Score: Medium

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process, although the SWAMP as a whole recently underwent a thorough external evaluation and the program is developing a formal business plan

Score: Medium

Rivers

[should this include NAWQA, which only measures water quality, and not any biological indicators?]

Website: NAWQA – <http://ca.water.usgs.gov/nawqa.html>; State 303(d) List – http://www.swrcb.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml; Impaired Water Bodies – http://www.cacoastkeeper.org/impaired_waterbodies/

Sponsor: NAWQA – US Geological Survey; State 303(d) List – State Water Board; Impaired Water Bodies – California Coastkeeper

Description: See the description of NAWQA above (p. 12) in the Drinking Water – Surface Water subtheme. The periodic 303(d) listing process identifies water bodies and water body segments that do not meet designated beneficial uses pertaining to aquatic life (and other uses). While there is a statewide listing policy, it is applied somewhat differently within each regional board region. There is no coordinated statewide monitoring program for all beneficial uses, and listing decisions are made using all available data. California Coastkeeper provides these listings in a map-based interface that enables users to visualize listings by region and category of pollutant.

Evaluation:

1. Strategy, objectives, design: The State’s 303(d) listing program asks and answers clear questions, with specific audiences in mind, and listings are used as the basis for management decisions about implementing specific responses, such as Total Maximum Daily Loads (TMDL) programs, to water quality problems. However, with the exception of NAWQA, there are no coordinated statewide monitoring programs for assessing rivers, with the result that data used in the 303(d) listing process for rivers is gathered for a variety of objectives, using a variety of monitoring designs. This requires regional board staff to conduct site-specific and ad hoc efforts to determine which data meet the objectives of the assessment and listing process

Score: Low

2. Indicators and methods: Other than for NAWQA, there are no indicators, sampling, or quality assurance methods that are standardized statewide

Score: Low

3. Data management: See the description of NAWQA and CIWQS data management protocols and tools above (p. 12) in the Drinking Water – Surface Water subtheme. However, there are a number of other data sources used in the periodic 303(d) assessment process. Each regional water board [get info on data handling process at regional and state levels]

Score: Medium

4. Consistency of assessment methods: NAWQA produces assessments using consistent methods statewide. While there are standardized water quality criteria for many parameters, regulatory targets may also differ widely across the state depending on each region’s Basin Plan and the requirements of individual TMDLs. In addition, each regional water board may interpret the

state's 303(d) listing criteria somewhat differently, with the result that assessments of impairment in rivers statewide do not reflect a consistent and standardized assessment approach

Score: Low

5. Reporting: NAWQA and CIWQS provide query and reporting products and tools that focus on water quality and not directly on measures of aquatic life. The State Board's 303(d) listing website provides tabular summaries and explanations of listings in each region, but does not provide access to the underlying monitoring data

Score: Low

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process

Score: Low

Additional monitoring programs: Other monitoring programs that collect data potentially relevant to the assessment of aquatic life in rivers include regional watershed monitoring programs such as those for the Sacramento, San Gabriel, and Los Angeles Rivers.

Lakes

[TBD]

[Not sure what to use here]

Coastal waters: Shallow marine reefs

Website: CDFG CRANE – <http://www.dfg.ca.gov/marine/fir/sss.asp#crane>; Reef Check – http://www.reefcheck.org/rcca/rcca_home.php

Sponsor: Department of Fish and Game; Reef Check

Description: CDFG's Cooperative Research and Assessment of Nearshore Ecosystems (CRANE) is a collaborative effort between the California Department of Fish and Game (CDFG), various universities, private organizations, and government programs to gather and report data for fishery management and performance of marine protected areas. In 2004, funding was available for a wide-scale survey and report of fish and invertebrate populations in shallow, rocky habitats accessible to divers (Monterey to San Diego, including the Channel Islands). Reef Check California aims to support the CRANE program by establishing a network of volunteers trained to carry out surveys of nearshore reefs providing data on the status of key indicator species.

Evaluation:

7. Strategy, objectives, design: The programs ask and answer clear questions, with specific audiences in mind. However, there is no direct link to management actions. Specific monitoring objectives are stated on the Reef Check website (but not the CRANE website) and are to assess the relative abundance and size distribution of target species and how these parameters are changing over time. This will permit the evaluation of population and community attributes at sites inside and outside of existing and proposed Marine Protected Areas and will provide insight into how different sites respond to newly imposed management measures. The monitoring design is standardized statewide and is described in CRANE's 2006 summary report and in detail on the Reef Check website. Both programs have scientific advisory teams who provide input and feedback to ensure the scientific quality of the programs' data

Score: High

8. Indicators and methods: Indicators are standardized statewide and are described in CRANE's 2006 summary report and on the Reef Check website. Basic quality assurance procedures are described very briefly in CRANE's 2006 report. A quality assurance plan, with detailed procedures, is posted on Reef Check's website. These procedures are included in Reef Check's 4 – 5 day volunteer training program, which includes both classroom and field training in the sampling and data management protocols

Score: Medium

9. Data management: The basic data flow is described in CRANE's 2006 report. Reef Check's data management procedures are well established and clearly defined, and include standardized data entry forms. The program has a designated full-time database manager. Summarized data (e.g., mean, standard error) are available as tables in a PDF document. However, there are no tools for searching or downloading raw data from either website or exporting them to other formats. Nor are the databases from the two programs integrated

Score: Medium

10. Consistency of assessment methods: Data analysis methods are described in CRANE's 2006 summary report and Reef Check's 2006 – 97 report, and consist of the preparation of summary descriptive statistics, correlation analyses, and multivariate pattern analysis. There are no assessment frameworks or thresholds for evaluating and comparing condition

Score: Medium

11. Reporting: Data summary reports and the 2006 analysis and assessment report are available on the CRANE website. Reef Check also produced a two-year report assessing data collected in 2006 and 2007. Analyses included basic descriptions of abundance and distribution, as well as spatial pattern analyses. Users do not have the ability to define and run reports using their own criteria, nor are reports of the two programs coordinated or integrated

Score: Medium

12. Program sustainability: There is no readily available description of a periodic program planning or evaluation process

Score: Low

Coastal waters: Intertidal

Website: <http://www.marine.gov/>

Sponsor: Cooperative interagency group

Description: The MARINE partnership of local, State, and Federal agencies, universities and private organizations monitors rocky intertidal sites along the coast of California, including the islands, on a long-term basis. It represents the largest program of its kind on the west coast. Many of the sites have been monitored consistently for 15-20 years. A standardized set of Core Protocols are used to monitor rocky intertidal habitat each fall and spring at 89 MARINE sites. These data are funded by multiple partners and are entered into a common database for analysis. Sites are spaced every 10 to 15 miles along the coast on the mainland and offshore islands. Continuous monitoring provides resource managers with early warnings of abnormal conditions, such as the discovery of the withering foot syndrome which has affected black abalone across the coast.

Evaluation:

1. Strategy, objectives, design: MARINE asks and answers clearly defined set of questions about status and long-term trends, as defined by an interagency Steering Committee. Specific monitoring objectives are not defined on the program's website, but can be inferred from the program's overall goals and the analysis approaches. The monitoring and sampling protocols are established by an interagency Science Panel. These are standardized statewide and described in detail on the program's website and in publications and reports accessible from the website. The monitoring design and sampling protocols are targeted directly at the program's goals to describe status and long-term trends

Score: High

2. Indicators and methods: Indicators and methods are standardized statewide, with allowances for regional differences in species distributions, and are described on the program's website and in reports and publications available from the website. Quality assurance is conducted by each program partner; however, quality assurance methods are not described on the program's website

Score: Medium

3. Data management: Data management protocols are established by a Database Panel, but are not described on the program's website or in any reports listed on the website. Data are transferred to a central database, which is currently being organized with standardized formats. Data are not available remotely but must be requested from the MARINE program
Score: Medium
4. Consistency of assessment methods: The program is working with state agencies in their evaluation of discharges into Areas of Special Biological Significance, and with monitoring of marine protected areas. Indices of intertidal community health being generated by MARINE will allow condition to be categorized and federal and state agencies to assess measures to reduce impacts to this critical shoreline habitat. The website enables users to generate simple time plots of the abundance of individual species at specific sites
Score: Medium
5. Reporting: MARINE partners have produced a large number of reports and publication based on the program's monitoring data, and these are listed on the program's website
Score: High
6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process
Score: Low

Coastal waters: Subtidal benthos

Website: Bight Program – <http://www.sccwrp.org/sitemap.html#Regional>; CCLEAN – www.cclean.org

Sponsor: Bight Program – Southern California Coastal Water Research Project (SCCWRP); CCLEAN – several dischargers and the Central Coast Regional Water Board

Description: Both the Bight Program in southern California and the Central Coast Long-term Environmental Assessment Network (CCLEAN) are comprehensive regional monitoring programs that focus on the condition of key indicators of ecosystem health, including subtidal benthos, along the nearshore shelf. Both programs also include elements designed to identify and quantify linkages between terrestrial sources of pollutants and effects in the marine environment. The Bight Program conducts a synoptic survey of the Southern California Bight once every four to five years, while CCLEAN conducts monitoring year-round on an ongoing basis.

Evaluation:

1. Strategy, objectives, design: Both programs ask and answer clearly stated questions, with specific audiences in mind. Both programs define specific objectives and link these to explicit monitoring and data analysis designs. Both programs provide detailed descriptions and documentation on their respective websites. However, the two programs operate in distinct parts of the state and are not coordinated in any way
Score: High
2. Indicators and methods: Both programs use indicators and monitoring methods that are standardized across their respective program activities within reach region, but are not standardized statewide. All sampling and analysis methods, as well as quality assurance procedures, are available on each program's website
Score: High
3. Data management: Data management procedures for both programs are well established, though they are not described on the programs' respective websites. CCLEAN does not provide data download capabilities. The Bight Program website allows users to map stations according to measurement type or broader survey type, and to download entire surveys (e.g., infaunal abundance) of particular data types. However, the mapping function is limited and not linked to the data download function. There are no readily available options to query the database and select subsets of data for specific locations or times
Score: Medium

4. Consistency of assessment methods: Assessment methods are consistent within each program. The Bight Program has developed standardized assessment thresholds for infaunal communities that allow them to be subset into different categories of impact. The CCLEAN program has not developed or applied similar assessment tools
Score: Medium
5. Reporting: Both programs regularly produce detailed assessment reports and make them available on their respective websites. However, neither program provides ad hoc query tools that would enable users to produce customized reports
Score: Medium
6. Program sustainability: Both programs have a medium- to long-term funding base that reflects the results of internal planning processes. However, this information is not provided on the programs' websites
Score: High

Coastal waters: Enclosed bays and estuaries

[add regional Harbors Monitoring Program in S CA?]

Website: SQO –

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/reports/sedimentqual_baysestuarie.pdf; http://www.swrcb.ca.gov/water_issues/programs/bptcp/sediment.shtml; RMP – <http://www.sfei.org/rmp>; IEP – <http://www.iep.water.ca.gov/>; Bight Program – <http://www.sccwrp.org/sitemap.html#Regional>

Sponsor: SQO – State Water Board, RMP – San Francisco Estuary Institute (SFEI); IEP – multiple state and federal agencies; Bight Program – SCCWRP

Description: There are four major programs that focus, with some degree of overlap, on bays and estuaries. The only one that is statewide is the State Water Board's sediment quality objectives program. This is a multiyear effort to develop and implement objectives for enclosed bays and estuaries that protect aquatic ecosystems and human health from the direct (e.g., toxicity) and indirect (e.g., health impacts from eating contaminated seafood) effects of sediment contamination. The program has focused primarily on the development of an impact assessment framework and associated thresholds, monitoring methods, and standardized assessment tools. The program conducted a statewide assessment of sediment quality, using available data, to demonstrate the applicability of the approach and obtain an initial estimate of the percentage of the area of bays and estuaries falling into different categories of impact. The new objectives will be included in permits and will form the basis of expanded monitoring requirements. Two of the remaining programs focus on the San Francisco Bay and Delta, the San Francisco Estuary Institute's Regional Monitoring Program (RMP) for San Francisco Bay and the Interagency Ecological Program (IEP). The RMP is funded by a consortium of dischargers in the region and managed by a Steering Committee including consortium members and the Regional Water Board. The program focuses on a set of questions related to the management of contaminant impacts and aquatic resources. The IEP is funded and managed by a consortium of several state and federal agencies (US EPA, US Army Corps of Engineers, US Bureau of Reclamation, National Marine Fisheries Service, US Geological Survey, US Fish and Wildlife Service, Department of Water Resources, Department of Fish and Game, State Water Board). The IEP focuses primarily on the impacts to the Delta of water withdrawals and has developed several long-term datasets tracking the status of key ecological resources. These programs are not yet well integrated.

Evaluation:

1. Strategy, objectives, design: All programs ask and answer clear questions, with specific audiences in mind. All programs state clear objectives, with some defined in greater detail, and there are substantial differences in objectives across all four programs. Monitoring designs also differ substantially, largely due to differences in program objectives and in the structure and dynamics of large vs. small bays and estuaries. For example, the SQO only loosely defines monitoring requirements, while the other three programs have well-established monitoring designs.

Monitoring objectives and designs are well described on the programs websites and their respective designs have not been integrated

Score: Medium

2. Indicators and methods: Indicators for the sediment quality objectives program are standardized statewide and well developed and described in summary form in the statewide assessment report and in greater technical detail in a series of reports available on the State Water Board's sediment quality objectives website. Indicators and methods for the other three programs are standardized within each program, and described on their respective websites, but are not well coordinated or standardized across programs

Score: Medium

3. Data management: Data management procedures are well developed for the IEP, RMP, and Bight Program and all data are available on the programs' respective websites. Data from the statewide SQO assessment are currently housed at SCCWRP and procedures have not been established for ongoing capture of new sediment quality data, maintenance of the database, or inclusion of the database in the BDAT/CEDEN system. Data from the RMP and IEP are readily accessible through a variety of map-based and menu-driven query and download tools that enable users to define subsets of data. The IEP data are housed in and directly accessible from larger data repositories such as CEDEN and BDAT. The Bight Program website allows users to map stations according to measurement type or broader survey type, and to download entire surveys (e.g., infaunal abundance) of particular data types. However, the mapping function is limited and not linked to the data download function. There are no readily available options to query the database and select subsets of data for specific locations or times

Score: Medium

4. Consistency of assessment methods: Analysis and assessment methods for the sediment quality objectives program follow detailed and standardized protocols described in summary in the statewide assessment report and in greater technical detail in a series of technical reports available on the State Water Board's website. The other three programs also describe their assessment methods, but use program-specific approaches that are consistent within each program but not coordinated or standardized across programs. The sediment quality objectives program is the only program that has defined formal, regional and statewide assessment thresholds for categorizing condition. All programs have formal mechanisms in place to manage the development, review, validation, and updating of their assessment approaches

Score: Medium

5. Reporting: A statewide sediment quality objectives assessment report is available on the State Water Board's sediment quality objectives and SWAMP websites. However, there are no interactive features to enable users to focus on a specific area or directly obtain the underlying data through a link to the database. Plans for future reporting have not been developed. The other three programs provide a large number of reports on their respective websites that address a range of issues related to contamination, anthropogenic sources, and ecological status. None of the programs have the capability to interactively produce user-defined reports

Score: Medium

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process for the sediment quality objectives program. The other three programs have formal planning and evaluation processes overseen by management committees. However, these planning processes are independent of each other

Score: Medium

Wetlands

[add California Wetlands Information System – Resources Agency]

Website: CRAM – <http://www.cramwetlands.org/>; Wetland Tracker - <http://www.wetlandtracker.org/>

Sponsor: State Water Board

Description: The California Rapid Assessment Method (CRAM) is a standardized, cost-effective tool for assessing the health of wetlands and riparian habitats. CRAM software guides users through assessment procedures that are applicable to all wetland types. It is designed for assessing ambient conditions within watersheds, regions, and throughout the State. It can also be used to assess the performance of compensatory mitigation projects and restoration projects. The CRAM portal provides a mechanism for independent monitoring programs to apply the method and enter their data into a centralized system. CRAM data and results are also accessible through the State Water Board's Wetland Tracker, which is intended to eventually become the portal for entry into all wetlands monitoring and assessment data for the state.

Evaluation:

1. Strategy, objectives, design: The program asks and answers a clear question, with specific audiences in mind. The monitoring objective is to provide rapid, scientifically defensible, standardized, cost-effective assessments of the status and trends in the condition of wetlands and related policies, programs and projects throughout California. There is a three-level monitoring design, recommend by the Wetlands Recovery Project. However, this is not universally applied and individual monitoring programs with somewhat different designs can all enter their data into the CRAM database.

Score: Medium

2. Indicators and methods: Indicators and monitoring methods are well developed and standardized, though they are in the last phase of field testing and final revision. The schedule for training sessions is posted on the CRAM website, as are detailed methods manuals and user guides. There is no systematic quality assurance applied to data submitted to the site. Funds exist (104b3 and CIAP) to develop regional "audit teams" of trained CRAM experts for coastal regions that will provide third-party review of selected CRAM results by re-CRAMming the sites.

Score: Medium

3. Data management: Data management procedures are well established and data are housed in a database maintained by SFEI. The CRAM methodology is being field tested and finalized and the CRAM database is being updated regularly to reflect these adjustments and will not be integrated with BDAT / CEDEN until it has stabilized. The database has preprogrammed routines for remote data entry by participants. At this time, there are no tools for search, selecting, and downloading data, although this functionality is included in the CIAP project that begins this fall. The funded task includes downloading by site, combination of sites, wetland type, watershed (Cal Water 2), congressional district, Water Board, and statewide.

Score: Medium

4. Consistency of assessment methods: CRAM is level 2 of a three-level assessment strategy for wetlands that begins at the landscape level and ends at the detailed site level. Assessment thresholds are well developed and standardized statewide. Software to apply the CRAM metrics and user manuals are available for download from the program's website. The CRAM database will eventually be merged with the Wetland Tracker database to allow users to visualize extent and condition assessments simultaneously. For each wetland type, at each of several scales, Wetland Tracker will generate a "report" of the size-frequency of all wetland polygons, the size-frequency of the wetland polygons for projects, the CRAM condition frequency (by attribute and site score) for all sites, and for project sites.

Score: High

5. Reporting: The website has a Google Maps interface that displays all wetlands in the system. Clicking on specific sites brings up summary information for that wetland and a chart of CRAM scores. Wetlands can also be selected from a drop-down list of available sites and viewed regionally via the interactive mapping function of Wetland Tracker (www.wetlandtracker.org), although not all wetland scores are visible at every scale. However, no reports summarizing and

synthesizing results have been prepared. Access to these and other information about wetlands will be centralized through a main wetlands portal, perhaps CERES, that has not yet been decided

Score: Medium

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process, although program planning is managed by the Wetlands Monitoring Council.

Score: Medium

Fisheries: Anadromous fish

Website: CalFish – www.calfish.org/portals/2/Home/tabid/70/Default.aspx

Sponsor: The Resources Agency, Department of Fish and Game, Department of Water Resources, Coastal Conservancy, Caltrans, Pacific States Marine Fisheries Commission, NOAA Fisheries

Description: This coordinated, state and federal interagency effort is intended to create, maintain, and enhance high quality, consistent data that are directly applicable to policy, planning, management, research, and recovery of anadromous fish and related aquatic resources in California, and to provide data and information services in a timely manner in formats that meet the needs of users. Its primary intent is to centralize access to fisheries and habitat monitoring and assessment data in California. This will make it much easier to develop and maintain statewide data standards and promote further development of related data programs.

Evaluation:

1. Strategy, objectives, design: The portal's overall strategy is broad but clearly stated. Monitoring objectives are defined by each of CalFish's cooperating agencies and vary depending on each agency's mission and the goals of specific programs. Monitoring objectives are available through links to agency programs provided on the website. As for monitoring objectives, monitoring designs are defined by CalFish's cooperating agencies and vary depending on individual program goals. Designs for many programs are available through links provided on the website

Score: Medium

2. Indicators and methods: Monitoring indicators focus on measures of abundance and distribution and the cooperating agencies work to standardize these across programs. However, there is no information about standardization efforts directly available on the website. Quality assurance procedures are established and implemented by each cooperating agency. There is no information about quality assurance directly available on the website

Score: Medium

3. Data management: Data management procedures are established and implemented by CalFish's cooperating agencies. In addition, there is a broader effort among CalFish's participants to standardize formats to improve access to and integration of data from multiple sources. The website provides links to published data collection and documentation standards and encourages their broader use. Users are able to view data via two basic methods: querying the database tables directly or querying the data geographically. The geographical queries are made possible with an interactive on-line mapping system. This system also provides access to a broad array of framework data (political boundaries, hydrography, quad maps, and many more) that make the spatial data even easier to analyze and understand. Because the tabular and geographical databases are linked, users can move easily between the two systems

Score: Medium

4. Consistency of assessment methods: Given the wide range of issues related to anadromous fisheries, there is no single statewide assessment approach adopted by all agencies. Instead, data analysis and assessment is conducted by CalFish's cooperating agencies to meet their specific needs. However, the website provides descriptions of and links to assessment tools that may be of use to broader audiences, such as a method, developed by the Department of Fish and Game Information Services Branch for deriving salmonid distribution from existing observation data

and creating GIS layers identifying this distribution. As another example, the interactive mapping tool enables users to map a wide variety of abundance and distribution data against various habitat, water quality, and management parameters

Score: Medium

5. Reporting: CalFish produces no reports of its own, though a variety of assessment reports are available from each of the cooperating agencies. CalFish does allow users to search the integrated database and create custom reports on population trends and counts, distributions, migration barriers, and fish genetics, as well as view information on individual monitoring programs, hatcheries, and habitat restoration projects

Score: High

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process

Score: Low

Fisheries: Freshwater fish

[Fish and Game freshwater fish site, IEP]

Fisheries: Marine fish

[Fish and Game marine fish site, NMFS/NOAA]

Invasive species

[check DFG site]

Harmful algal blooms

[combine with Shellfish theme, which includes toxic phytoplankton monitoring?]

Stressors and processes

Loadings

[Bight and SF RMP regional programs, estimates for individual rivers developed by NPDES stormwater programs, Dept. Pesticide Regulation Pesticide Information Portal and pesticide use reporting]

Flows

[include other higher resolution flow monitoring re NPDES / TMDL, but much less coordinated]

Website: CDEC – <http://cdec.water.ca.gov/>

Sponsor: Resources Agency

Description: The California Data Exchange Center (CDEC) installs, maintains, and operates an extensive hydrologic data collection network including automatic snow reporting gages for the Cooperative Snow Surveys Program and precipitation and river stage sensors for flood forecasting. CDEC provides a centralized location to store and process real-time hydrologic information gathered by various cooperators throughout the State. CDEC then disseminates this information to the cooperators, public and private agencies, and news media.

Evaluation:

1. Strategy, objectives, design: The program meets well-defined information needs of specific audiences. The program's monitoring objectives are to provide real-time hydrologic information. There is no standardized monitoring design applied statewide. CDEC obtains and organizes data provided by a wide range of cooperative partners, each with its own monitoring design
Score: Medium
2. Indicators and methods: The basic set of hydrologic indicators is well defined and methods are standardized to some degree across the major participating agencies. CDEC's emphasis on the provision of real-time data for specific decision-making needs precludes the application of rigorous quality checks of the data. The time required for such quality assurance would make the data substantially less useful to the program's customers. The level of quality assurance is appropriate to the needs of the users and, after much discussion, the program decided that correcting inaccuracies in the data and releasing revised datasets would not be worth the effort. The program's website notes that data are preliminary in nature. However, the level of quality assurance applied to the data is not documented on the program's website
Score: Medium
3. Data management: Data management procedures are well defined and systematically applied. CDEC operates a data exchange program with various federal and state agencies and other public agencies. This data exchange program involves the automated transfer and receipt of data and information via network connections. Automated query routines permit searches by station, parameter, and a variety of other entry points
Score: High
4. Consistency of assessment methods: There is little analysis or assessment, since CDEC's primary purpose is to ensure the ready availability of real-time hydrologic data. However, an automated data plotting tool enables users to prepare graphs of query results. The program's website has clear instructions and is suited for both public access and to provide data downloads for analysts and researchers
Score: Medium
5. Reporting: CDEC's website provides access to a large number of reports, the majority of which are data reports on various aspects of hydrologic condition. There are no provisions for interactive reports except as noted under Data Management
Score: High
6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process
Score: Low

Levels of contamination: Freshwater

[NPDES inland POTW & stormwater; SWAMP; USGS NAWQA – see drinking water]

Levels of contamination: Marine waters

[Major regional programs – Bight, CCLEAN, CenCOOS, SCCOOS]

Levels of contamination: Freshwater sediment

[not sure what to use here]

Levels of contamination: Marine sediment

[Major regional programs – Bight, CCLEAN]

Levels of contamination: Freshwater aquatic life

[SWAMP sportfish; nothing for other taxa]

Levels of contamination: Marine aquatic life

[also add tissue chemistry from Bight Program]

Website: NA

Sponsor: State Water Board

Description: The California Mussel Watch Program, which has just begun sampling, is based on NOAA's historical Status and Trends Program and is being conducted in coordination with NOAA. The program's goal is to continue the earlier time series of broad measures of coastal contamination.

• **Evaluation:**

1. Strategy, objectives, design: The program asks and answers a clear question, with specific audiences in mind. Monitoring objectives have been clearly stated by the National Status and Trends Program and are to track larger-scale patterns and longer-term trends in contamination of aquatic life in the coastal zone. The monitoring design was established by the National Status and Trends Program and has been updated with new sites selected in coordination with the MARINE intertidal monitoring program. The monitoring design is described in work plans for the northern and southern California components of the program, but is not available online

Score: High

2. Indicators and methods: Indicators are well defined and standardized both nationally and statewide, and sampling methods are defined in standard operating procedures that are part of the workplans. Quality assurance methods are well defined and standardized both nationally and statewide

Score: High

3. Data management: The California program has only recently been restarted and data management procedures have not yet been established

Score: Low

4. Consistency of assessment methods: Data analysis methods are standardized nationwide and consist primarily of descriptive summaries of patterns and trends. There are no assessment thresholds used to categorize condition. The State Water Board and NOAA are still in discussions regarding who will conduct data analysis

Score: Medium

5. Reporting: The newly reconstituted program has not yet produced reports or developed a formal reporting strategy

Score: Low

6. Program sustainability: There is no readily available description of a periodic program planning or evaluation process

Score: Low

- Landscape maps
- Measures of climate change

Ocean acidification

[NOAA surveys, OOS data]

- Infrastructure
 - Landscape, etc.
 - Department of Conservation Farmland Mapping and Monitoring Program

Prioritizing next steps

The evaluation identifies specific shortcomings in the existing system of monitoring programs and theme-based portals that will be resolved as part of the ten-year implementation plan called for in the Act. It is important to prioritize implementation in a way that optimizes the effectiveness of available resources, addresses issues of most concern to managers and the public as soon as possible, takes advantage of existing infrastructure, and builds momentum and support for the overall concept of expanding the use of theme-based portals.

The Monitoring Council considered three key factors in developing its set of priorities (Table 4):

- Level of concern to the public and managers
- Level of effort involved (based on the evaluation in Chapter 3)
- Near-term opportunities (i.e., low-hanging fruit) involving interested monitoring / assessment programs, immediate sources of funding, or situations that demonstrate technical methods or institutional arrangements that further the goals of SB 1070

In terms of improving access to monitoring data and assessment results, the Monitoring Council judged that drinking water safety is the paramount concern to the greatest number of people, with seafood consumption safety and swimming safety the next two priorities. In general, the status of aquatic life is a lower priority, although there are specific subthemes, such as anadromous fishes and their habitat, or shallow marine reefs, that rise to a higher priority at certain times and places for some audiences. In terms of the level of effort required to meet the goals of SB 1070, the summary ratings in Table 3 provide a useful relative measure of needed effort. The greater the number of “High” ratings for any given theme or subtheme (see Table 3), the lower the effort involved. In addition, the Monitoring Council has identified a number of opportunities for demonstrating the feasibility of different approaches to meeting SB 1070’s goals. In some cases (e.g., swimming safety), this reflects the fact that effective web portals have already been developed and need only a small amount of additional design and integration effort. In other cases (e.g., wetlands), an existing effort has obtained funding and has expressed a desire to collaborate directly with the Monitoring Council’s efforts.

Table 4. Summary results of the prioritization exercise. For each criterion, smaller numbers represent a higher priority. The overall priority is the simple average of the individual ratings on three separate criteria. [Draft ratings are shown for illustrative purposes. Scores could be weighted if desired, rather than using the simple average]

Theme-based portals	Prioritization Criteria			Overall priority
	Level of concern	Level of effort	Opportunity	
<i>Drinking water safety</i>				
Surface water	1		3	
Groundwater	1		3	
Water at the tap	1		2	
<i>Seafood consumption safety</i>				
Sportfish	2	2	1	1.7
Shellfish	2	1	2	1.7
<i>Swimming safety</i>				
Freshwater	2	4		
Beaches, bays, and estuaries	2	1	1	1.3
<i>Status of aquatic life</i>				
Wadeable streams	3	1	1	1.7
Rivers	3	3		
Lakes	3	3		
Coastal waters				
Shallow marine reefs	3		2	
Intertidal	3		2	
Subtidal benthos	3		2	
Enclosed bays and estuaries	3		2	
Wetlands	3	2	1	2.0
Fisheries				
Anadromous fish	2		2	
Freshwater fish	3		3	
Marine fish	3		3	
Invasive species				
Harmful algal blooms				
<i>Stressors and processes</i>				
Loadings	3		4	
Flows	3		4	
Levels of contamination				
Water				
Freshwater	3		4	
Marine	3		4	
Sediment				
Freshwater	3		4	
Marine	3		3	
Aquatic life				
Freshwater	3		4	
Marine	3		2	
Invasive species	3		4	
Harmful algal blooms	3	2	1	2.0

Prioritization Criteria				
Theme-based portals	Level of concern	Level of effort	Opportunity	Overall priority
Landscape maps	3		2	
Measures of climate change	2		3	
Ocean acidification	2		3	
<i>Infrastructure</i>				
???				

Chapter 4: Implementation Plan

The Monitoring Council has developed a four-part implementation plan designed to meet the goals of SB 1070 over the ten-year period defined by the Act. These components include:

- Developing a single, global point of entry to the complete set of theme-based web portals
- Improving monitoring and assessment programs, and their related web portals, to address the shortcomings described in the evaluation presented in Chapter 3
- Developing a comprehensive monitoring program strategy that addresses overall coordination, duplication of effort, and data gaps within and between programs
- Organizing the technical, organizational, and financial infrastructure needed to ensure the long-term sustainability of the Monitoring Council's standardization and data access efforts

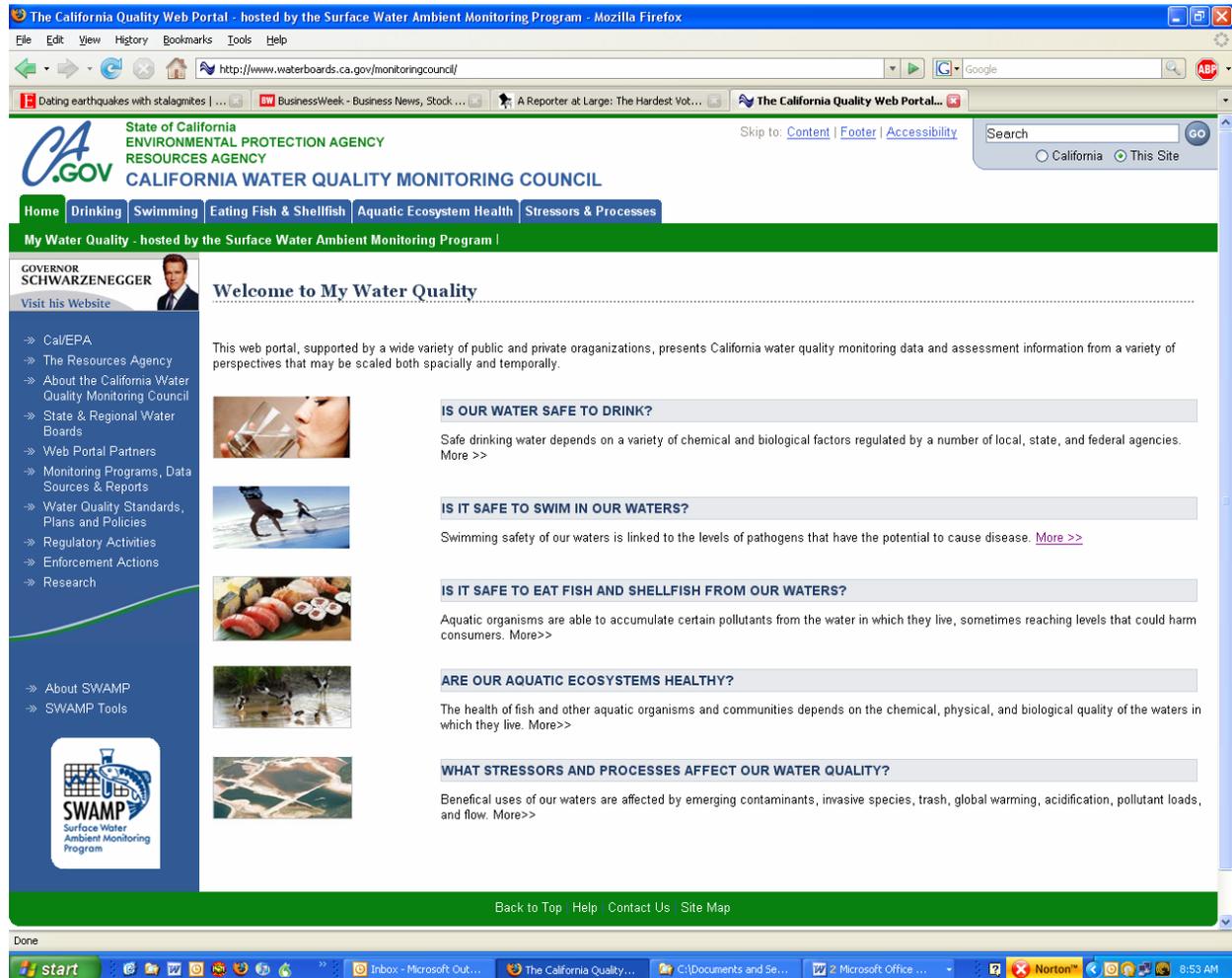
The implementation plan is intended as a roadmap for action by the State Water Board and the Resources Agency.

Global point of entry

The Monitoring Council has created a working test version of a website (Figure 1) that will ultimately provide a single, global point of entry to monitoring and assessment information for the full range of themes and subthemes listed in Table 1. The website is designed around intuitively clear questions that are readily understood by managers, the public, and scientists:

- Is our water safe to drink?
- Is it safe to swim in our waters?
- Is it safe to eat fish and shellfish from our waters?
- What is the condition of our aquatic resources?
- What stressors and processes affect our water quality?

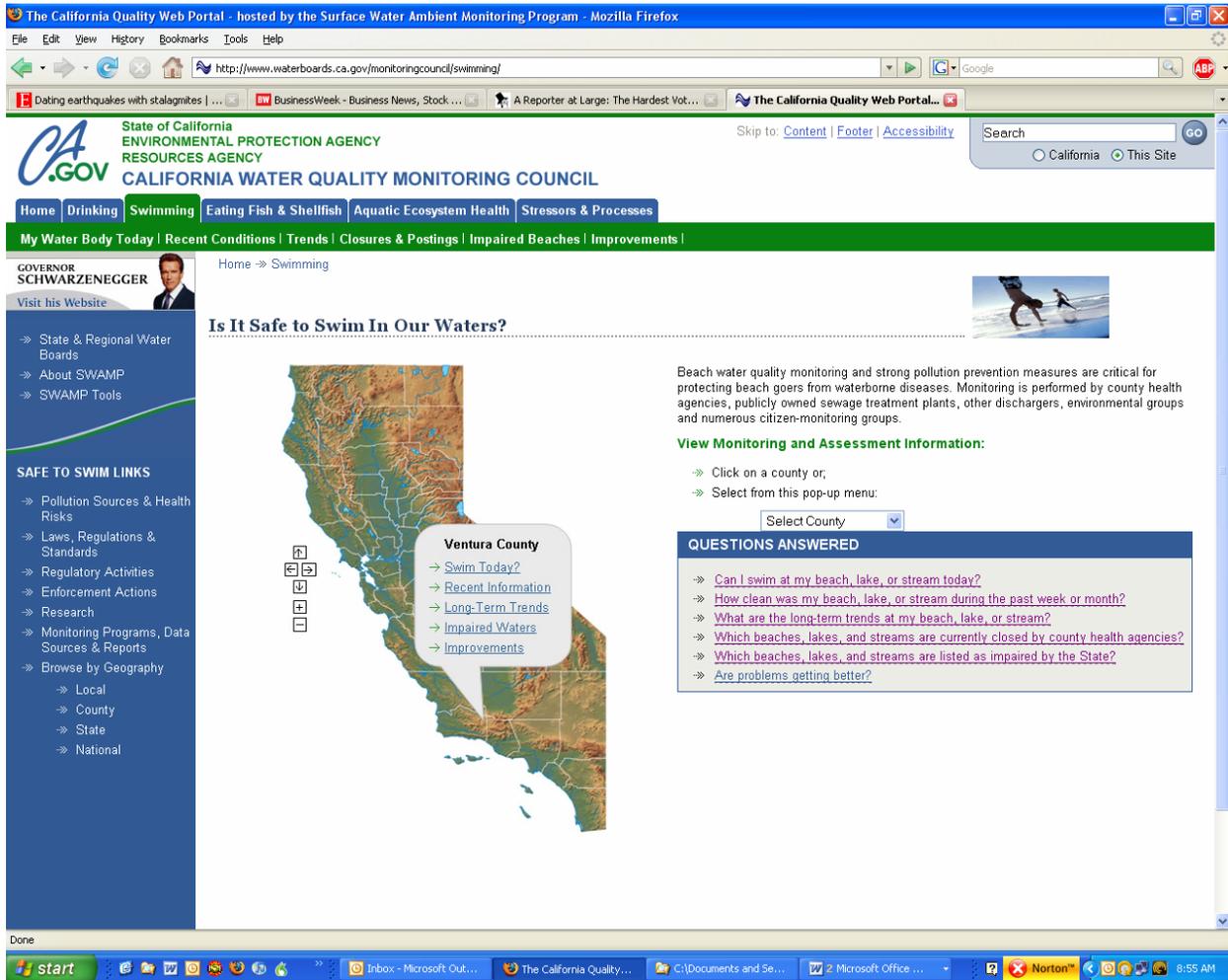
Figure 1. Draft Monitoring Council homepage, designed as a global entry point to monitoring and assessment information for all themes and subthemes.



Each question leads to a series of pages for each theme (see Figure 2 for the draft page for swimming safety) that provide map-based access in the center of the page to summary assessment products and more detailed monitoring data, as well as tools for downloading data and conducting ad hoc queries and analyses. Links along the left-hand side of each page will enable users to access management and technical information specific to each theme. In some cases, the Council's theme-based pages will simply link to existing, well-developed web portals. In other cases, new portals will need to be developed, either by the Monitoring Council itself or by agencies or collaborative groups.

[Describe relationship to SWAMP website]

Figure 2. Draft Monitoring Council page for the theme Is It Safe to Swim In Our Waters?



Theme-based pages, such as that illustrated in Figure 2, provide a structural mechanism for identifying, organizing, and accessing existing data and information, thus fulfilling one of SB 1070's key goals. In addition, they provide a concrete framework within which the Monitoring Council and theme-based workgroups (see Ensuring Longer-Term Sustainability, below) can negotiate and resolve issues related to webpage formats and information linkage structures.

Improving individual portals

The evaluation rating benchmarks (Table 2), together with the fact sheets and ratings in Chapter 3, provide a template for identifying the specific actions needed over a ten-year period to bring all portals up to a rating of High on all six attributes. Actions needed to improve web portals can be subdivided into three broad categories:

- Create web portals where none currently exist
- Standardize core program and portal features across currently uncoordinated efforts
- Improve specific capabilities of existing portals

As previously mentioned, the evaluations in Chapter 3 provide the basis for identifying actions needed to improve each portal by addressing specific shortcomings. Some actions are fairly targeted, e.g., add the

capability to download data, while others are broader and much more challenging, e.g., develop standardized assessment methods and endpoints. A complete list of all recommended actions for each portal is provided in Appendix 1, organized to match the structure of the fact sheets. [need to develop plan or schedule for how to complete these actions]

The Monitoring Council also selected three subthemes, and their related web portals, for immediate action, on the expectation that this would result in near-term successes that would demonstrate the feasibility and utility of the theme-based web portal approach and the institutional structure the Council proposes to establish to support such efforts. These subthemes include:

- Seafood consumption safety for sportfish
- Swimming safety at beaches, bays, and estuaries
- Wetlands

While these do not rate the highest level of concern associated with drinking water, and may require a moderate level of effort, the Monitoring Council selected them as immediate priorities for several reasons.

First, participants in each effort are interested in and supportive of the Monitoring Council's efforts. For example, the Wetlands Monitoring Council requested that they be recognized as a workgroup of the Monitoring Council, working directly with the Monitoring Council. Similarly, State Water Board staff involved in the beach monitoring program have actively cooperated in developing the web portal mockup, and the Clean Beaches Initiative has funded additional work to prepare assessment results and reports for inclusion in the Council's web portal targeted at swimming safety. Heal the Bay has also expressed its strong support.

Second, these efforts are at a relatively advanced stage of development. They all include well-defined monitoring strategies, objectives, and designs, and have succeeded in standardizing many aspects of their data management and assessment approaches. In addition, they either have functioning web portals or portals that are under active development. Finally, they have independent sources of funding that enable them to collaborate with the Monitoring Council's efforts.

Third, these three existing efforts provide an attractive opportunity for the Monitoring Council to build support for the overall SB 1070 effort by demonstrating the feasibility of achieving the goals set by SB 1070. Achieving a substantial degree of success with three highly visible issues will promote new relationships and help attract additional funding sources to support the Monitoring Council's efforts.

The following sections describe the proposed approach for fostering the development of the three target portals and integrating them more fully with the Monitoring Council's portal.

Seafood (sportfish) consumption portal

[Describe workplan. Substance of existing effort, management and funding, main goals drawn from the Ch. 3 evaluation and SFEI / SWAMP / OEHHA plans. Describe working relationship with Monitoring Council.]

Swimming safety at beaches portal

[Describe workplan. Substance of existing effort, management and funding, main goals drawn from the Ch. 3 evaluation and Heal the Bay's plans. Describe working relationship with Monitoring Council.]

Wetlands portal

[Describe workplan. Substance of existing effort, management and funding, main goals drawn from the Ch. 3 evaluation and Wetland Monitoring Council's plans. Describe working relationship with Monitoring Council.]

Comprehensive monitoring strategy

[Demonstrate how the theme-based portal concept, with its focus on monitoring and assessment, provides the basis for development of a statewide monitoring and assessment network that cuts across agencies. Build on the existing SWAMP program and integrate the SWAMP business plan and its draft statewide assessment framework. Include SWAMP's assessment and data management approaches as one starting point.]

Addresses the following specifics:

1. Developing a general strategy for achieving comparability
2. Role of the Monitoring Council (see Ensuring Longer-term Sustainability, below) in establishing overall policies and guidelines
3. Role of individual agencies (see next section re organizational structure)

Describe how the process of improving portals will create the opportunity for identifying and removing redundancies, as well as filling existing gaps in data and capabilities.]

Ensuring longer-term sustainability

[Actions needed to ensure that monitoring programs and portals are sustainable, including the design, implementation, and maintenance of the organizational and technical infrastructure needed to support the portals.]

Organizational issues

[Discuss organizational options for managing the ongoing effort. Propose that Monitoring Council continue as a permanent body, with subcommittees and working groups to deal with specifics. Discuss the safe to swim and wetlands themes, as well as SWAMP, as examples of building relationships with other groups. Model some features on existing standards-setting bodies that have a similar structure. Describe in general how the ten-year plan will be phased in stages that focus on state agency monitoring programs in the short term and then expand to include other organizations over the longer term. Describe Council role and general benchmarks for meeting the SB 1070 deliverables:]

1. A comprehensive monitoring program strategy (10-year timeframe)
2. Indicators that provide a basic minimum understanding of the health of the state's waters
3. Quality management plans and quality assurance plans
4. Methodology for compiling, analyzing, and integrating readily available information
5. An accessible and user-friendly electronic data system
6. Production of timely and complete water quality reports and lists (303d/305b/beaches)
7. Update of the State Water Board's Surface Water Ambient Monitoring Program]

Data integration infrastructure

[Discuss technical issues related to hosting, database integration, maintenance, how to incorporate existing efforts at data integration and web access. Describe infrastructure issues. Develop staffing plan. The following paragraphs represent some preliminary thoughts about IT approaches and infrastructure. Emphasis is on using existing systems and tools. Need to describe and discuss data integration and access issues across the entire data path.]

There are challenging issues related to the design and implementation of the data integration and data access infrastructure envisioned in the Act. There are no design elements generic to all web or data portals and data and information types will be widely varied, depending on the theme / subtheme. The California Environmental Data Exchange Network (CEDEN) and the Environmental Protection Agency's (EPA) National Environmental Information Exchange Network (NEIEN) can be used to create homes for monitoring data that need them and for linking databases that are now separate. CEDEN specializes in ambient monitoring data and provides data management, outreach, educational, quality assurance, organizational, and other services to a range of distinct programs. CEDEN's goals are to help standardize monitoring designs, improve data quality, expand system interoperability, support SWAMP's statewide data formats, and establish mechanisms for transferring data to the statewide CEDEN network. CEDEN is available for groups who need a system to share, integrate and manage their ambient monitoring data.

The NEIEN uses national standards for identifying environmental attributes (such as naming species or analytes) and open source web services for linking external systems together. NEIEN has a consensus based institutional framework for modifying these standards and technologies as needed. The NEIEN includes data and information types in addition to ambient monitoring data, which are conveyed by CEDEN, and plans to include additional types in the future. CEDEN is linked to the NEIEN using web services.

Web services using the NEIEN protocols can be used to link relevant data systems that are external to CEDEN and help implement the SB 1070 data and information sharing plan when these external systems have data and information types that CEDEN and NEIEN have components to handle. Integrating data into CEDEN and NEIEN would need to be evaluated on a case by case basis for intuitional and technical feasibility and cost.

The technologies for other SB 1070 information types that need to be integrated using applications other than linking web pages, would need to be determined. These technologies, their cost and the effort to implement them would need to be determined on a case by case basis and employ a Software Development Lifecycle (SDLC) methodology.

On a statewide basis, this will require a large amount of effort. Depending on the requirements, there could either be links to the query tools of those sites, or server-side programming which queries for specific data from those sites and presents it in a customized way. Again, the requirements would be crucial in determining how the data would be acquired and delivered. For example, if the data is to be acquired and displayed in real time, this would involve utilizing available API's or perhaps application to application data communications, such as web services. This presumes such tools are available (as would be with CEDEN or the NEIEN) and that the permission to connect to these resources is granted. If such tools are not available, as in the case of sites that only present data via interactive web-interface query tools, a screen-scrapers could be programmed to extract the necessary data. However, if the requirements do not specify real-time data access, the data may be acquired by other means. The specifications should include the minimum refresh rate for the data. Different topics may require different data refresh rates. In the case where the data can be gathered in a batch mode, agreements might be made with data providers for periodic data transfers, using ftp or web services.

The NEIEN has already linked with other national systems such as the USGS NWIS (is currently working with NOAA on data exchanges) and within the state is linking with CEDEN and other groups who collect and manage data related to air releases, pesticides, drinking water, land use restrictions, hazardous waste and hazardous materials. The national standards utilized by NEIEN are reached through consensus and are updated regularly through committee. Service Orientated Architectures (SOAs) are already available for retrieving and analyzing data which would greatly reduces state costs when developing these types of applications.

CEDEN specifically works with ambient monitoring data producers within the state, linking them together, first, regionally at Regional Data Centers (RDCs), then statewide. CEDEN uses statewide standards developed by the Surface Water Ambient Monitoring Program (SWAMP). Many groups are required to monitor and provide data using the SWAMP standards. The CEDEN data model is distributed and is focused on working with the data collectors (through the RDCs) and helping them manage, monitor, quality assure, and then convey their data to CEDEN using the SWAMP standards while retaining the primary copy of their data.

There are a variety of issues that must be considered when choosing any of the options listed above. If real-time data access is a requirement, some issues of concern are performance, programming complexity, maintainability, and site reliability. The time it takes to establish a network connection, authenticate with the host machine, query and retrieve what may be a large dataset and format it for download or display could be quite lengthy. Other issues involved would be the complexity of communicating with heterogeneous environments, network links of varying latencies, and unpredictable failures in the network or the computers. For batch data retrieval, there are a plethora of issues that must be addressed. One is data storage. If the data is to be stored in a relational database, there would be automated processes which map and upload incoming files. The server side programming would also need to extract local data and format it as required.

Designing this sort of system can be simple or complex, depending upon the requirements. The SDLC methodology is used to determine requirements. Use cases can be used to determine functional requirements (what the system does – inputs, behaviors, outputs). Non-functional requirements such as performance parameters would also be defined during the SDLC.

Costs and funding

[Discuss costs and funding.]

Chapter 5: Recommendations

[Summarize specific steps, especially from Ch. 5]

This focuses on the SB 1070 requirement for “recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are maintained and available for use by decision makers and the public”]

Appendix 1: Theme-by-Theme Implementation Actions

Drinking water safety

Surface water

- | | |
|---------------------------------------|--|
| 1. Strategy, objectives, design: | Improve coordination of strategy, objectives, and designs for NPDES programs statewide |
| 2. Indicators and methods: | Improve standardization of core indicators and methods for NPDES programs statewide. Evaluate utility of coordinating across USGS and NPDES programs |
| 3. Data management: | Evaluate utility of linking USGS and CIWQS systems.
Improve query and data download capability for SWP and other DWR sites |
| 4. Consistency of assessment methods: | Improve consistency of assessment for NPDES programs statewide, including thresholds for categorizing condition |
| 5. Reporting: | Develop interactive reporting features on USGS and DWR |
| 6. Program sustainability: | Coordinate planning and evaluation of NPDES programs statewide |
| Additional programs: | Evaluate utility of including additional programs in portal |

Groundwater

- | | |
|---------------------------------------|--|
| 1. Strategy, objectives, design: | Coordinate GAMA and GeoTracker objectives and designs |
| 2. Indicators and methods: | Include quality assurance information in GeoTracker portal |
| 3. Data management: | Add query and download features to GAMA portal, perhaps through link to GeoTracker. Include information on data management procedures on GeoTracker portal |
| 4. Consistency of assessment methods: | No actions needed |
| 5. Reporting: | Develop interactive reporting features on GAMA portal |
| 6. Program sustainability: | Provide description of program planning and evaluation |

Water at the tap

- | | |
|---------------------------------------|-----|
| 1. Strategy, objectives, design: | TBD |
| 2. Indicators and methods: | TBD |
| 3. Data management: | TBD |
| 4. Consistency of assessment methods: | TBD |
| 5. Reporting: | TBD |
| 6. Program sustainability: | TBD |

Seafood consumption safety

Sportfish

1. Strategy, objectives, design: Modify SWAMP design to better meet OEHHA's information needs
2. Indicators and methods: Develop quality assurance tiers that reflect users' analysis and assessment needs
3. Data management: Create data formats and online database, as well as web portal with interactive mapping and data query tool
4. Consistency of assessment methods: Complete development of standardized assessment methods and include these on new web portal
5. Reporting: Develop web-based ad hoc reporting capability
6. Program sustainability: Develop program planning and evaluation process and include description on new web portal

Shellfish

1. Strategy, objectives, design: Improve coordination of phytoplankton and toxin monitoring designs
2. Indicators and methods: Cooperate with NOAA in effort to improve methods standardization. Develop quality assurance procedures and provide information on data quality on web portal
3. Data management: Provide description of data management procedures on web portal
4. Consistency of assessment methods: Develop assessment thresholds for phytoplankton and toxins in marine waters, if needed
5. Reporting: Develop capability to create ad hoc reports based on users' criteria
6. Program sustainability: Develop program planning and evaluation process and include description on new web portal

Swimming safety

Freshwater

1. Strategy, objectives, design: Develop basic monitoring strategy, objectives, and design using Beach Water Quality Workgroup approach as a model
2. Indicators and methods: Improve standardization of core indicators and methods for NPDES programs statewide
3. Data management: Develop statewide database modeled on that for beaches
4. Consistency of assessment methods: Improve consistency of assessment methods
5. Reporting: Develop reporting capability modeled after that for beaches
6. Program sustainability: Develop program planning and evaluation process

Beaches, bays, and estuaries

- | | |
|---------------------------------------|--|
| 1. Strategy, objectives, design: | No actions needed |
| 2. Indicators and methods: | Incorporate improved indicators when they are developed |
| 3. Data management: | Streamline data flow among monitoring groups, county health agencies, State Water Board, and Heal the Bay; |
| 4. Consistency of assessment methods: | No actions needed |
| 5. Reporting: | Reformat State Water Board's Beaches and Clean Beaches Initiative webpages to reflect Monitoring Council's design approach |
| 6. Program sustainability: | Develop program planning and evaluation process |

Status of aquatic life

Wadeable streams

- | | |
|---------------------------------------|--|
| 1. Strategy, objectives, design: | No actions needed |
| 2. Indicators and methods: | Develop suite of IBIs applicable to broader range of habitats.
Complete methods comparison with CRAM |
| 3. Data management: | Complete formats for bioassessment data. Develop tiered quality assurance requirements to facilitate the capture of additional monitoring data |
| 4. Consistency of assessment methods: | No actions needed |
| 5. Reporting: | Develop interactive query and reporting features. Complete redesign SWAMP website in terms of major themes and subthemes |
| 6. Program sustainability: | Complete and implement SWAMP business plan |

Rivers

- | | |
|--|--|
| 1. Strategy, objectives, design: | Develop statewide strategy and objectives for river monitoring; improve coordination of river monitoring designs |
| 2. Indicators and methods: | Improve standardization of core indicators and methods for key river monitoring programs statewide. Evaluate utility of coordinating across USGS and other programs |
| 3. Data management: | Evaluate utility of linking USGS, CIWQS, and 303(d) data management systems. Provide access to data underlying the 303(d) listings and develop integrated query and data download capability |
| 4. Consistency of assessment methods: | Develop standardized assessment approach, including thresholds for categorizing condition. Improve statewide consistency of 303(d) listing approaches applied to rivers |
| 5. Reporting: | Develop coordinated statewide assessments of rivers.
Improve assessment reports that provide the underlying rationale for 303(d) listings |
| 6. Program sustainability:
Additional programs: | Develop program planning and evaluation process
Evaluate utility of including additional programs in portal |

Lakes

- | | |
|---------------------------------------|-----|
| 1. Strategy, objectives, design: | TBD |
| 2. Indicators and methods: | TBD |
| 3. Data management: | TBD |
| 4. Consistency of assessment methods: | TBD |
| 5. Reporting: | TBD |
| 6. Program sustainability: | TBD |

Coastal water: Shallow marine reefs

- | | |
|---------------------------------------|---|
| 1. Strategy, objectives, design: | No actions needed |
| 2. Indicators and methods: | Standardize quality assurance methods across all program partners. Include detailed quality assurance methods on websites |
| 3. Data management: | Standardize data management procedures across all program partners. Describe data management procedures more fully on websites. Develop query and data download tools |
| 4. Consistency of assessment methods: | Develop assessment approach, including thresholds for categorizing condition |
| 5. Reporting: | Improve coordination of reporting methods and formats across program partners. Produce statewide assessment reports. Develop capability to produce user-defined reports |
| 6. Program sustainability: | Develop program planning and evaluation process |

Coastal waters: Intertidal

- | | |
|---------------------------------------|---|
| 1. Strategy, objectives, design: | No actions needed |
| 2. Indicators and methods: | Standardize quality assurance methods across all program partners. Include detailed quality assurance methods on websites |
| 3. Data management: | Standardize data management procedures across all program partners. Describe data management procedures more fully. Develop query and data download tools |
| 4. Consistency of assessment methods: | Develop assessment approach, including thresholds for categorizing condition |
| 5. Reporting: | Improve coordination of reporting methods and formats across program partners. Produce statewide assessment reports. Develop capability to produce user-defined reports |
| 6. Program sustainability: | Develop program planning and evaluation process |

Coastal waters: Subtidal benthos

1. Strategy, objectives, design: Improve coordination of monitoring designs
2. Indicators and methods: Standardize indicators and sampling, analysis, and quality assurance methods across programs
3. Data management: Standardize data management procedures as needed across programs. Describe data management procedures more fully. Develop improved query and data download tools for both programs
4. Consistency of assessment methods: Adapt assessment approaches as needed and apply standardized assessment approach statewide
5. Reporting: Produce statewide assessment reports. Develop capability to produce user-defined reports
6. Program sustainability: Describe planning and evaluation process on programs' websites

Coastal waters: Enclosed bays and estuaries

1. Strategy, objectives, design: Improve coordination of monitoring objectives and designs
2. Indicators and methods: Improve coordination and standardization of indicators and methods. Describe quality assurance methods more fully on program websites
3. Data management: Develop procedures for aggregating sediment quality data at the statewide level. Improve integration of different program databases, perhaps using CEDEN or BDAT as a central repository. Describe data management procedures more fully. Develop improved query and data download tools, especially for Bight Program and sediment quality objectives program
4. Consistency of assessment methods: Develop standardized assessment methods in addition to sediment quality. Apply standardized assessment approach statewide
5. Reporting: Improve coordination at the regional level, particularly in the San Francisco Bay / Delta area. Produce statewide assessment reports. Develop capability to produce user-defined reports
6. Program sustainability: Describe planning and evaluation processes on programs' websites. Improve coordination of planning at regional and perhaps statewide level